THE IDENTITY OF EAGLEWOOD (*GYRINOPS*, THYMELAEACEAE), A NEW ECONOMIC RESOURCE FOR PAPUA NEW GUINEA

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ABSTRACT

Gyrinops ledermannii (Thymelaeaceae) is identified as the tree involved in the eaglewood trade. Several taxa are currently being confused with *G. ledermannii* but the true eaglewood is readily distinguished by its floral characters.

TOK IGO PAS (MELANESIAN TOK PISIN)

Diwai ol i kolim *Gyrinops ledermannii* (Thymelaeaceae) long tok latin na igalwud or gaharu long tok malaia na nau em tu nem mipela i save long Papua New Guinea. *Gyrinops*, em nau i kamap wanpela diwai insait long maket bilong salim na baim dispela diwai. Pastaim sampela luksave long lif na flawa bilong dispela diwai ino bin kamap klia tumas. Tasol nau i gat wei bilong luksave long ol flawa na lif bilong trupela diwai igalwud.

INTRODUCTION

In recent years, a lucrative trade has emerged in the Hunstein subdistrict of East Sepik Province, involving a natural product commonly known as 'eaglewood' (Fig. 1). The newly established market is based on an arborescent species which accumulates aromatic oils in older wood. Demand for the fragrant wood can be likened to that for sandalwood, *Santalum* spp. (Santalaceae). However unlike sandalwood, the eaglewood essence appears to be a contingent response to injury or trauma, rather than a normal outcome of maturation. In its most desirable form, eaglewood becomes blackened by concentrated deposits of aromatic compounds, attracting prices of K800–1,000 per kg for the highest grades. Following separation of the oils, the fragrant extracts are currently used in the production of expensive incense and perfumes, for eventual purchase by Asian consumers.

Due to its recent appearance in commerce and unusually high value, eaglewood has become the focus of intense interest. Although the product is known primarily from lowland and low montane forest, there has been considerable uncertainty over the identity and number of species involved in the current trade. In an attempt to resolve the taxonomic issues, the eaglewood source areas near Ambunti township were visited by the authors in August 2001,

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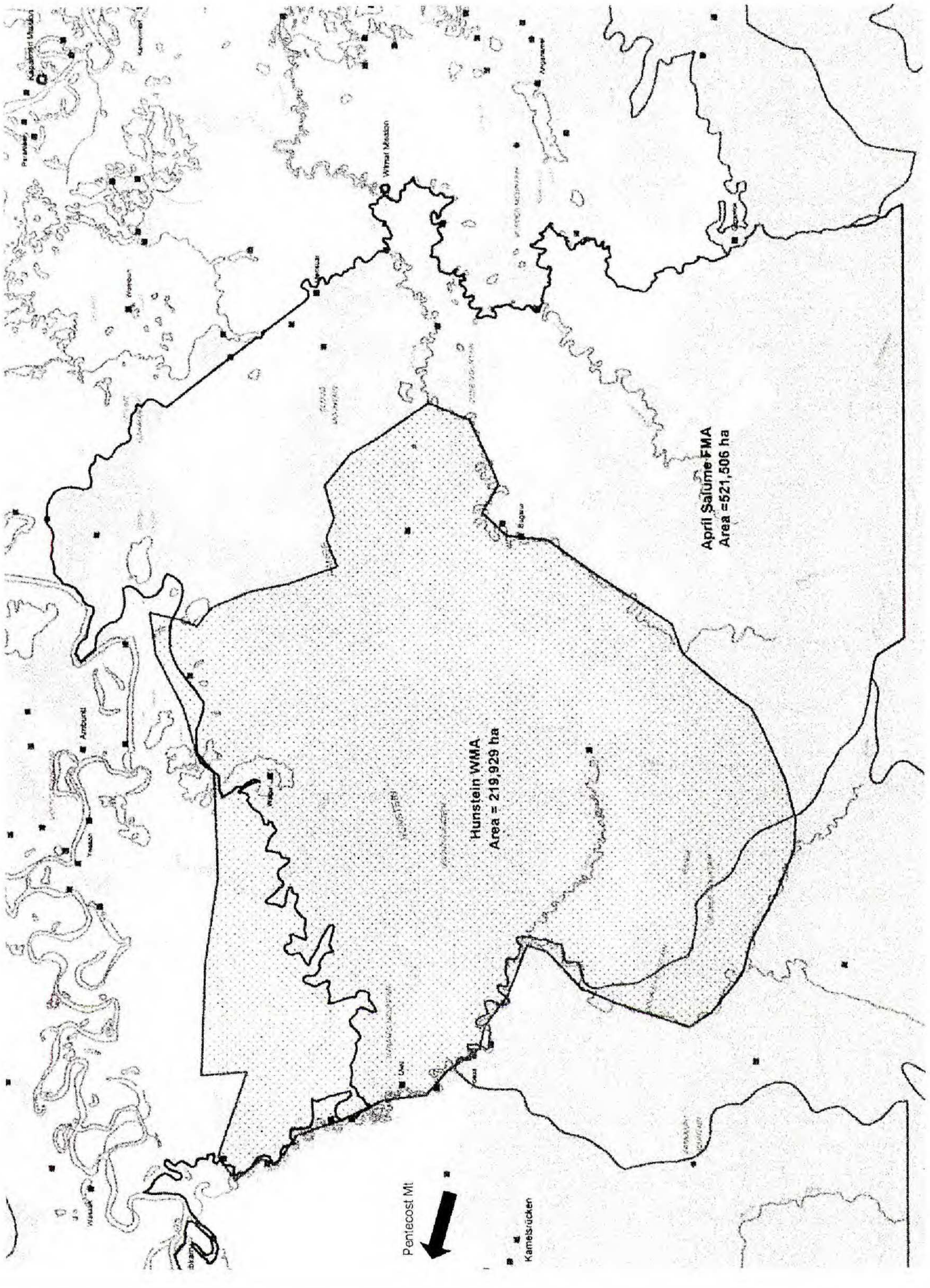

FIG. 1. Hunstein subdistrict, the principal geographic source for eaglewood. Most of the known populations are in the Hunstein WMA (dot stipling), but the distributional center for *Gyrinops ledermannii* probably lies further west. Gray shading indicates areas of closed canopy forest.

as part of a general floristic study of the upper Sepik. The following account presents the results of these investigations.[1]

TAXONOMY OF EAGLEWOOD

During the 1989 National Geographic Society expedition to Mt. Hunstein (cf. Bakker 1994; Sohmer et al. 1991), over 1,200 botanical specimens were obtained from areas where eaglewood is now harvested. Among the survey vouchers was *Takeuchi 4848* (A!, LAE!), collected from a tree described by village guides as having a fragrant black wood which could burn even when wet. This specimen was identified as *Gyrinops ledermannii* Domke on the original distribution (also confirmed in 1995, cf. annotation on the A duplicate), a species considered endemic to the upper Sepik and previously known with certainty only from the type gathering (*Ledermann 7401*; Pentecost Mt along the May River). The identification of the 1989 collection was facilitated by comparisons against two additional specimens obtained within the last 50 years, but the other reference materials have since disappeared from the Lae National Herbarium.

The Ledermann locality lies ca. 100 km WNW of the April River site designated as 'Kamelsrücken' (Samsai Mt) by early German explorers. Samsai villagers report that eaglewood is very common on the west-facing slopes of Kamelsrücken, in the direction of Pentecost Mt. Because the original specimen was taken from the May River, the local testimony implies that the distributional center for the species lies further to the west of existing production areas. The Hunstein populations are possibly only secondary occurrences.

Although Ledermann's type was lost in the 1943 destruction of Berlin Herbarium, the National Geographic survey voucher was unambiguously keyed to the given species using Ding Hou (1960). After eaglewood became a resource deserving of scrutiny, suspicion was thus directed to *Gyrinops* as the likely source for the new product.[2] However, in the absence of herbarium material specifically identified as eaglewood by local producers, it was difficult to be sure of the presumed correspondence. Especially as eaglewood was recently discovered in Jayapura (West Papua or Papua Barat, the former Irian Jaya), where it is there identified as *Aquilaria filaria* (Oken) Merr. (Thymelaeaceae), considerable confusion existed over the plant's identity.

A fertile collection taken during our Ambunti reconnaissance (*Towati & Golman 159*) was pointed out by village suppliers as an example of the tree harvested for the eaglewood trade. The Ambunti voucher includes both flowers and fruits, and its completeness leaves no room for doubt that *Gyrinops ledermannii* is the Hunstein eaglewood. In the Ambunti specimen, the pen-

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[1]The original submission of this manuscript was made to another journal in 2001, but subsequently withdrawn.

[2]A similar conclusion and an extensive discussion of eaglewood has been independently reported by Zich and Compton (2001) while this paper was in submission.

tamerous flowers have the same number of stamens as calyx lobes, each stamen also alternating with a fimbriate petaloid appendage. This clearly eliminates *Aquilaria* from consideration, because in that genus the number of stamens is twice that of the calyx lobes (Ding Hou 1960). *Aquilaria filaria* is otherwise very similar to *Gyrinops ledermannii*, particularly in their shared characteristic of loculicidal capsules that develop by rupturing through one side of the corolla tube. It is easy to get the two species confused unless the flowers are carefully examined. Reports of eaglewood being present in West Papua, and its identification as *Aquilaria filaria*, need to be reevaluated. *Aquilaria* has thus far been recorded in New Guinea only from the Vogelkop region, so its alleged presence at other West Papuan localities such as Jayapura is not unreasonable. Due to the similarities between the respective taxa, it is entirely plausible that *Aquilaria* represents another source for eaglewood. However photographs of the Jayapura provenance taken by M. Golman are more suggestive of *Gyrinops ledermannii* than of *Aquilaria filaria* (Figs. 2, 3).

Uncertainty over the identification of eaglewood is also evident among local villagers searching for the plant. Thymelaeaceae is a prominent family in the Hunstein flora, with very close similarities among its representatives. Within the existing source areas, *Phaleria coccinea* (Gaud.) F.v.M. (Thymelaeaceae) is the species most often mistaken for eaglewood. In superficial aspect its inflorescence is comparable to *Gyrinops*, and the leaves are also of similar appearance, particularly with respect to venation. As with other members of the family, *Phaleria coccinea* has an extremely strong inner bark which is often used in the construction of white bilums (i.e., local netbags used as carry-alls) noted for their soft texture.

Due to the black color of the branchlets, *Diospyros papuana* Val. (Ebenaceae) is also mistaken by villagers for eaglewood, even though the differences in morphological aspect are rather obvious. For example, unlike eaglewood the leaf venation in *D. papuana* is bifacially prominulous, and the fruits are indehiscent and large. The flowers are also unisexual and dioecious, rather than bisexual. Table 1 summarizes some of the salient distinctions between *Gyrinops ledermannii* and the plants with which it is presently confused.

In addition to the problems caused by similarities with other taxa, *G. ledermannii* is highly variable and can exhibit considerable difference in leaf size between individuals. The collection from the 1989 survey has lanceolate blades averaging 5.0 × 2.5 cm but the more recent material has elliptic leaves ca. 19.5 × 6.5 cm. Presumably these distinctions are at least partly under environmental control, especially in view of the wide range of substrates comprising eaglewood habitat (cf. Takeuchi & Golman 2002:63–64; this issue). The nondescript nature of the vegetative characters also discourages effective identification of sterile plants, thus adding to the confusion.

FIG. 2. Eaglewood from Jayapura. The numerous and obscure lateral veins are characteristic of both *Gyrinops ledermannii* and *Aquilaria filaria*. Photo by M. Golman, August, 2001.

FIG. 3. Flowering branchlet from the Jayapura population. The internal structure of the flower is critical to the proper identification of eaglewood. Photo by M. Golman, August, 2001.

TABLE 1. Comparative list of reproductive characters for *Gyrinops ledermannii* and the taxa with which it is confused in the field. Tokples names are provided with the village locality where the name originates. Voucher source: H&C = R. Hoogland and L. Craven, CSIRO survey from 1966; T = W. Takeuchi, Hunstein surveys from 1989, 1995.

Scientific name/Tokples name	Flower	Fruit
Gyrinops ledermannii Domke (Thymelaeaceae), may-hasei (Bugabugi, *T 15531*)	bisexual stamens same no. as calyx lobes; stamens included	small loculicidal capsule
Aquilaria filaria (Oken) Merr. (Thymelaeaceae), sp. not recorded from PNG	bisexual stamens 2 × no. of calyx lobes; stamens included	small loculicidal capsule
Phaleria coccinea (Gaud.) F.v.M. (Thymelaeaceae), wanyip or yaru (Wagu; *H&C 10371*); wonyip (Wagu; *H&C 10543*); winyap (Waskuk; *T 10193*)	bisexual stamens 2 × no. of calyx lobes; stamens exserted from floral tube	small drupe
Diospyros papuana Val. (Ebenaceae) manukway (Ambunti; *H&C 10214*); mankall (Waskuk; *T 10227*)	unisexual, dioecious stamens 3–4 × no. of calyx lobes; stamens included	large berry

DISCUSSION

Although the economic value of eaglewood affords the promise of substantial returns for stakeholders, high market prices clearly create incentives for overexploitation and eradication of natural populations. In order to ensure long-term viability of existing stocks, appropriate measures in resource management will eventually require enactment. However the present dearth of information on *Gyrinops ledermannii* will undoubtedly constrain its sustainable development. Even 90 years after its initial discovery, the plant remains poorly understood by botanical and forestry science. The demography, distribution, and ecology of *G. ledermannii* are unknown. This situation will require correction before eaglewood can be properly developed as an economic asset. There is also an obvious need for natural products research into the chemical principles which are responsible for eaglewood's desirable qualities. Depending on the nature of the resource, the species could conceivably serve as a valuable subject for silvicultural and natural products development.

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